Bonneville Power Administration
Fish and Wildlife Program FY98 Watershed Proposal Form

Section 1. General administrative information

Title **Satus Watershed Restoration**

Bonneville project number, if an ongoing project 9603501

Business name of agency, institution or organization requesting funding
Yakama Indian Nation

Business acronym (if appropriate) YIN

Proposal contact person or principal investigator:

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Subcontractors.

Organization	Mailing Address	City, ST Zip	Contact Name

NPPC Program Measure Number(s) which this project addresses.
7.6A-D, 7.8A, B, E

NMFS Biological Opinion Number(s) which this project addresses.

Other planning document references.
Strategies 2-7 for steelhead, Yakima Subbasin Plan, 1990
Wy Kan Ush Me Wa Kush Wit, Yakima River Subbasin Plan, basinwide recommendations 3-5, pp. 58-59.

Subbasin.
Yakima River

Short description.
Reestablish landscape level ecological processes disrupted by modern land uses. We are restoring normative interactions between soil, water, and vegetation necessary for creation and maintenance of the aquatic habitat essential to anadromous fishes.

Section 2. Key words

Mark	Programmatic Categories	Mark	Activities	Mark	Project Types
X	Anadromous fish		Construction	X	Watershed
+	Resident fish		O & M		Biodiversity/genetics
+	Wildlife		Production		Population dynamics
	Oceans/estuaries		Research	+	Ecosystems
	Climate		Monitoring/eval.	+	Flow/survival
	Other	X	Resource mgmt		Fish disease
			Planning/admin.		Supplementation
			Enforcement		Wildlife habitat en-
			Acquisitions		hancement/restoration

Other keywords.
Steelhead, watershed function

Section 3. Relationships to other Bonneville projects

Project #	Project title/description	Nature of relationship

Section 4. Objectives, tasks and schedules

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Reduce the ratio between peak and low flows.	a	Restore grass and woody vegetation in the Satus Creek corridor.
		b	Patrol and maintain range fences in the Satus Creek watershed, coupled with trespass penalties.
		c	Characterize and quantify streamflow

		e	Climatological monitoring.
		j	Experimental treatment development and evaluation.
		l	Enhance beaver habitat.
		n	Rehabilitate incised ephemeral and intermittent channels.
		o	Reintegrate fire as a landscape process.
2	Reduce erosion.	a	Restore grass and woody vegetation in Satus Creek corridor.
		b	Patrol and maintain range fences.
		j	Experimental treatment development and evaluation.
		k	Placement of large woody debris.
		l	Beaver habitat enhancement.
		n	Rehabilitate incised ephemeral and intermittent channels.
		o	Reintegrate fire as a landscape process.
3	Restore natural riparian and upland vegetation.	a	Restore grass and woody vegetation in the Satus Creek corridor,
		b	Patrol and maintain range fences.
		l	Beaver habitat enhancement.
		m	Plant ponderosa pine seedlings.
		n	Rehabilitate incised ephemeral and intermittent channels.
		o	Reintegrate fire as a landscape process.
4	Develop and assess large-scale, low input restoration treatments.	a	Restore grass and woody vegetation to the Satus Creek corridor.
		c	Characterize and quantify streamflow.
		d	Characterize suspended sediment transport.
		e	Climatological monitoring.
		f	Aerial photograph interpretation.
		g	Channel survey.
		i	Fisheries surveys.
		j	Experimental treatment development and evaluation.
		l	Beaver habitat enhancement.
		o	Reintegrate fire as a landscape process.

5	Improve aquatic habitat	a	Restore grass and woody vegetation in the Satus Creek corridor.
		b	Patrol and maintain range fences.
		d	Characterize suspended sediment transport.
		h	Characterize stream habitat conditions.
		j	Experimental treatment development and evaluation.
		k	Large woody debris placement.
		l	Beaver habitat enhancement.
		m	Plant ponderosa pine seedlings.
		n	Rehabilitate incised ephemeral and intermittent channels.
		o	Reintegrate fire as a landscape process.

Objective schedules and costs

Objective #	Start Date mm/yyyy	End Date mm/yyyy	Cost %
1	7/1996	12/2002	30.00%
2	7/1996	12/2002	25.00%
3	7/1996	12/2002	25.00%
4	7/1996	12/2002	10.00%
5	7/1996	12/2002	10.00%
			TOTAL 100.00%

Schedule constraints.
Weather is the major constraint on operations. Winter conditions can inhibit access over primitive roads or in stream channels. The length of the season for propagating vegetation is limited by duration of soil moisture.

Completion date.
Budgeted through 2002

Section 5. Budget

FY99 budget by line item

Item	Note	FY98
Personnel	THIS BUDGET IS FY98; OUTYEAR COSTS START WITH FY99	$405,666
Fringe benefits		$68,625

Supplies, materials, non-expendable property	office supplies, seed, herbicide, prescribed burning, erosion control	$68,446
Operations & maintenance	office rent, utilities, vehicles, fuel, repairs, insurance	$62,268
Capital acquisitions or improvements (e.g. land, buildings, major equip.)		
PIT tags	# of tags:	
Travel		$2,000
Indirect costs		$164868
Subcontracts	consultants, aerial photography, cattle impounding	$22,327
Other	training	$4,800
TOTAL		$799,000

Outyear costs

Outyear costs	**FY99**	**FY00**	**FY01**	**FY02**
Total budget	$539,423	$449,520	$476,491	$505,079
O&M as % of total	8.00%	8.00%	8.00%	8.00%

Section 6. Abstract

The Yakama Nation intends to increase the productivity of the Satus Creek summer steelhead population by restoring the ecological function of the Satus Creek watershed. Coordinated projects will address stream channel stability, riparian structure, diversity and productivity, and the health of upland range areas. Efforts to improve summer steelhead productivity are expected to also favor the reestablishment of coho and spring chinook.

To be successful, this effort must treat the watershed as a whole (Brooks, et al, 1991); accordingly, this proposal includes aquatic, riparian, and upland components. Uplands are significant because most of the watershed's precipitation falls on uplands, and maintaining base streamflows that support fish depends on detention and percolation of rainfall and snowmelt on uplands. The proposal outlines specific short-term projects which will effect immediate improvements in ecological function and demonstrate the value of coordinated actions in the restoration of degraded watersheds.

The concept of adaptive management implies experimentation with restoration and management techniques. Experimentation coupled with intensive monitoring may not be cost-effective on as large a scale as the entire Satus Creek watershed, however. The Yakama Nation proposes to experiment with restoration techniques in the Dry Creek subwatershed.

We will be developing ongoing records of fish population density and distribution, fish habitat, streamflow, climate, channel geometry, vegetative pattern and distribution, and selected wildlife populations. These records will be used to evaluate the effectiveness of restoration treatments, and watershed condition and functioning.

Section 7. Project description

a. Technical and/or scientific background.

Lying wholly within the Yakama Indian Reservation (YIR), the Satus Creek watershed, with an area of 612 square miles, comprises nearly ten percent of the Yakima River basin area. The two largest tributaries to Satus Creek are Dry Creek (158 square miles) and Logy Creek (109 square miles). Approximately 75% of the watershed is comprised of shrub-steppe rangelands, with most of the balance in forest. Satus Creek begins at an elevation of 5,500 feet on the north slopes of the Simcoe Mountains, near the south boundary of the Yakama Indian Reservation (YIR), and flows northeastward to the lower Yakima Valley.

Satus Creek and its tributaries are the most significant remaining natural production areas for the declining population of Yakima River steelhead. The Satus Creek summer steelhead run has accounted for as much as half the production in the Yakima River basin in recent years. This population has suffered a serious decline since monitoring began in 1988. This trend is unlikely to reverse itself soon, judging by the low outmigrations of summer steelhead smolts from the Yakima Basin. Poor smolt production also indicates that spawning and rearing conditions are limiting steelhead populations. Management of this watershed has profound implications for the Satus Creek steelhead run and, in turn, for the entire Yakima basin run.

The long term goal of the Yakama Indian Nation is to restore summer steelhead to harvestable levels, while maintaining the genetic integrity and adaptability of the population. The Yakima Subbasin Plan outlined in Volume II, *Wy-Kan-Ush-Mi-Wa-Kish-Wit*, establishes a summer steelhead adult return goal of 29,700 for the entire sub-basin. This will involve restoring terrestrial and aquatic habitat to conditions capable of supporting all freshwater life history stages of summer steelhead.

As noted in the FWP, "improv[ed] habitat quality [is] needed to increase the productivity of many stocks. Reduced habitat quality results in lower survival during critical spawning, incubation , rearing and migration periods.... Improved habitat quality would allow greater juvenile and adult survival at each freshwater life stage and can result in more offspring surviving to begin migration to the ocean.". Analysis of data collected indicates a suite of changes to the functioning of the Satus Creek watershed over the last 50 years. These changes include vegetative change across the watershed, increased drainage density, extensive road construction, stream diking and channelization, removal of large woody debris, channel changes (i.e., straightening, widening/bank erosion, channel incision, braiding), changes in the structure and composition of riparian vegetation, and a more extreme flow regime. While some of the observed habitat degradation is attributable to local disturbance, it is our working hypothesis that aquatic habitat is created by the watershed-scale interactions between water, soil, and vegetation. It follows that changes to these interactions will cause

changes to the habitat. The altered, more extreme flow regime observed in Satus Creek, accompanied by wide-spread habitat degradation not attributable to on-site disturbances, is indicative of impaired watershed functioning as a cause of the habitat degradation. This view of aquatic conditions being influenced by upland conditions is supported by the FWP: "Maintaining and improving the productivity of salmon and steelhead habitat ... requires coordination of virtually all activities that occur in a subbasin... [I]f watershed restoration is to be successful, instream restoration should be accompanied by riparian and upslope restoration. A comprehensive watershed approach can help fisheries resources recover from their depressed state". The Satus Watershed, by virtue of being under single ownership, and in a largely undeveloped state offers a nearly ideal opportunity to translate this perspective into action.

FWP 7.6A Habitat Goal: Protect and improve habitat conditions to ensure compatibility with the biological needs of salmon, steelhead and other fish and wildlife species. Pursue the following aggressively.

7.6A.1 Ensure human activities affecting production of salmon and steelhead in each subbasin are coordinated on a comprehensive management basis.

The Satus Creek watershed is a vital element in the Yakima River subbasin. The scope of this project includes the potential to coordinate the human activities throughout most of the watershed, and throughout all the steelhead spawning and rearing habitat in the watershed.

7.6A.2 At a minimum, maintain the present quantity and productivity of salmon and steelhead habitat. Then, improve the productivity of salmon and steelhead habitat critical to recovery of weak stocks. Next, enhance the productivity of habitat for other stocks of salmon and steelhead. Last, provide access to inaccessible habitat that has been blocked by human development activities.

Aquatic habitat in the Satus Creek watershed is being protected through the previously-mentioned grazing exclosures and leases (Kauffman and Kreuger, 1984, Kauffman et al, 1995). Additionally, habitat is being directly improved through relocation of floodplain road sections (Megahan, 1987), removal of dikes, riparian revegetation (Beschta, 1994), addition of large woody debris (National Research Council, 1992), reconnection of high flow channels. Restoration treatments aimed at restoring watershed functioning include headwater meadow restoration, beaver habitat improvement, revegetation, and prescriptions for controlled burning. Future activities will address implementation of controlled burning prescriptions, planning and implementation of progressive grazing management, wild horse management planning and implementation, road drainage improvements, and additional revegetation and headwaters restoration.

The Satus Watershed Project is an in-kind mitigation project. Key personnel include the interdisciplinary originators of the project proposal (hydrologist, watershed biologist, and fisheries biologist) who collectively have over sixteen years of experience working in the watersheds of the Yakama Reservation.

b. Proposal objectives.

The Yakama Indian Nation proposes to improve fish habitat in the Satus Creek watershed by ameliorating the effects of past and present land uses. Our measurable objectives are:

1. to reduce the ratio between peak and low flows,
2. reduce erosion,
3. restore natural riparian and upland vegetation patterns,
4. develop and assess large-scale, low-input restoration treatments, and
5. improve aquatic habitat.

Because this project is founded on the assumption that aquatic habitat is a function of watershed-scale interactions between soil, water, and vegetation, some objectives listed are intended as indicators of the appropriateness of those interactions. These watershed-scale processes will not change quickly, hence the monitoring of watershed functioning is intended to be a long-term effort.

Interim Products:

Annual reports on the activities undertaken, and summary of monitoring data collected and analyzed in the course of this project; publication of research findings; presentations at relevant symposia.

c. Rationale and significance to Regional Programs.

The rationale underlying this project is that because the Satus Creek watershed offers a nearly unique opportunity to apply 'ridgetop-to-ridgetop'restoration and management to a watershed critical to the Yakima River steelhead population, a large-scale, long-term restoration and monitoring effort is justified for this watershed. This project was originally proposed, both as an effort to restore the steelhead population of the Satus Creek watershed, and as an opportunity to develop large-scale, low input watershed treatments having off-site applications. This will require a commitment to long-term monitoring.

The rationale behind the restoration approach is that the stream/riparian system is an expression (integration) of the functioning of the entire watershed, i.e., the landscape-scale interactions between water, soil, and vegetation. Furthermore, the long-term sustainability of aquatic and terrestrial ecosystems rely on developing land uses which allow the water-soil-vegetation interactions to remain within a natural range of variability. Vegetation is the key to stabilizing soils and moderating the routing of water and sediment through the watershed; active and passive management of the vegetation is our primary tool for restoring watershed functioning and normative channel conditions. This approach is consistent with both *Wy-Kan-Ush-Mi-Wa-Kish-Wit*, and the goals and objectives of the FWP, as illustrated by the above quotations in Section 7a.

Opportunities for cooperation include:

1. The BPA-funded Yakima Fisheries Project's goal is to increase natural production of salmon and steelhead. Habitat improvements in the Satus Creek watershed support this goal.
2. The Yakama Nation's Lower Yakima Valley Wetlands and Riparian Area Restoration Project is receiving $4.9 million from the Bonneville Power Administration to purchase, restore and manage riparian lands along the Yakima River, lower Toppenish Creek, and in lower Satus Creek. These efforts will support the goal of the Satus Watershed Project.

d. Project history

The Satus Watershed Project was initiated in July, 1996. An extensive monitoring network has since been established for the measurement of climate and streamflow. The development of these records will create the opportunity to track the relationships between climatic input and watershed output. In this way, changes in watershed functioning can be identified. Although this intensity of watershed monitoring is not generally justified, it was included in this project because the unique opportunity to perform watershed-scale restoration treatments in the Satus watershed offered the potential for monitoring the effects of landscape-scale treatments. Concurrent fisheries population and habitat monitoring has been conducted to identify baseline populations and conditions.

Restoration treatments performed to-date include:

- Dike removal. We have removed over 700 linear feet of dike, and 2,500 cubic yards of dike material from the banks of Satus Creek. The larger material was used to construct sills with the objective of reconnecting high flow channels and increasing channel/floodplain interactions.
- Road removal. We have decommissioned 4 ½ miles of road located in the floodplain of a key reach spawning and rearing reach of upper Satus Creek. Two culvert crossings of Satus Creek have been removed; road drainage features have been altered to convert channelized surface flow to subsurface flow; final operations will include ripping and seeding of the road surface, and the removal of the culvert crossing from Wilson-Charley Creek at the bottom of the project area.
- Boulders. We treated another section of Satus Creek which had long ago been straightened to accommodate a highway by blasting a new channel through bedrock. We revegetated a fillslope prone to surface erosion, and placed boulders in the artificial channel to harbor juvenile and migrating adult steelhead.
- Gravel. A 15,000 cubic yard rock crushing operation was underway in December, 1997 to provide road surfacing material at stream crossings and other locations which contribute fine sediment to Satus Creek and its tributaries.
- Grazing. We are resting approximately 40% of the Satus Creek watershed from cattle grazing. This effort began in 1995 with the Satus Creek corridor, and was expanded to Logy Creek and uplands surrounding both streams in 1996. In 1997 we began a system of regular patrols, contacting ranchers or moving cattle ourselves to minimize trespass.
- Fire rehabilitation. Following forest and range fires in the Satus Creek drainage in 1994, 1996, and 1997, we fenced and revegetated burned areas, and mechanically rehabilitated fire lines and other sites associated with suppression efforts.
- Revegetation. 1) Floods in 1996 and 1997 created substantial fresh sediment deposits on the floodplains in the Satus Creek watershed. These areas were broadcast seeded with native grass seed as soon as they became accessible. 2) Experimental treatments were performed in winter/spring 1997 with willow propagation. Willow sticks were dumped into Satus and Dry creeks at various locations and differing flows. Other sticks were secured with at various locations in the stream bed. A subsample of sticks were marked from each treatment for monitoring survival rates and transport characteristics. Results will be published in the coming year. 3) Experimental

treatments were performed with root severing of aspen and cottonwoods to promote a suckering response. These treatments are being monitored. 4) Sedges were transplanted into incised intermittent stream channels to act as seed sources for downstream propagation.

- Meadow restoration. Incised channels have been treated to prevent further downcutting and headcutting, and to create sufficient stability that natural recovery can proceed. An area several hundred acres in extent has been cooperatively worked on by personnel funded by a Bureau of Indian Affairs watershed restoration grant, and by Satus Watershed Project personnel.
- Large woody debris (LWD) placement. Large windthrown trees, with rootwads attached, have been added to upper Satus Creek, using a combination of helicopter and excavator placement. Further excavator repositioning of LWD stranded by recent extreme high flows on the floodplains of Satus and Dry Creeks into the active channels is planned for January, 1998.
- Aspen regeneration. Aspen is in decline across the landscape due to changes in the disturbance regime which have severely reduced propagation. As the preferred beaver fodder, its decline has reduced beaver habitat. We have removed encroaching conifers in many of the aspen stands in the Satus Creek watershed, and will be applying treatments such as prescribed fire to stimulate propagation.

Adaptive management is central to achieving the Satus Watershed Project's restoration goals. Because the basin is entirely under the ownership of the Yakama Indian Nation and the YIN Fisheries Program is holding 5 year grazing leases for 40% of the basin, a unique opportunity exists to apply adaptive management. Small-scale, high-intensity restoration activities may be appropriate where acute problems exist (e.g. dikes), however, our restoration philosophy is to develop and apply large-scale, low input restoration techniques which are compatible with sustained economic land use, and which capitalize on natural processes and seasonal opportunity. Based on analysis of historical data, we are learning how land uses have contributed to fish habitat degradation. This provides a historical context for present day adaptive management prescriptions that can integrate watershed restoration and continued land management practices such as grazing, forest management, and prescribed burning.

e. Methods.

Following are the tasks we are undertaking:

A. Restore grass and woody vegetation in the Satus Creek corridor. Rest alone will not bring back native vegetation to the Satus Creek corridor. We are planting the good floodplain soils with wild rye, and the rocky soils with local woody vegetation. We have also partially controlled a 400-acre infestation of Scotch thistle; further treatments are needed to complete the job. We have had the involvement of a tribal archaeologist and a cultural resource specialist to ensure that cultural and archeological values are not compromised, and to provide an overview of historic and prehistoric land use.
The benefit from this task is reestablishment of the perennial native vegetation best suited to shade and stabilize Satus Creek, where it has been eliminated by cropping, overgrazing and noxious weed invasion. (Objectives 1, 2, 3, 4, and 5)

B. Continue the patrol and maintenance of range fences in the Satus Creek watershed. We currently patrol and maintain fences on all rangelands and stream corridors we manage under this project. This continuing task ensures secure boundaries for recovering areas, preventing new damage caused by livestock trespass. (Objectives 1, 2, 3, and 5)

C. Characterize and quantify streamflow. We have established ten permanent stream gaging stations to continuously measure stream discharge for Satus Creek and its two largest tributaries, Dry and Logy creeks. This information will be used to assess changes in the timing and quantity of flows, in relation to climatic conditions, and to conduct flood frequency analysis. We are using a set of staff gages and discharge measurements to characterize the flow regimes of intermittent and ephemeral streams. A long-term record of streamflow is vital to identifying changes in watershed functioning. (Objectives 1, and 4)

D. Characterize suspended sediment transport. We are taking regular turbidity measurements at all stream gaging sites and at other selected locations throughout the watershed. (Objectives 4, and 5)

E. Climatological monitoring. We have established eight permanent climate stations which continuously monitor precipitation and temperature across the watershed. This information will be used to establish and monitor changes in precipitation-streamflow relationships. (Objective 1, and 4)

F. Aerial photo interpretation. Photo interpretation data on changes in riparian vegetation along the Satus corridor has been derived from aerial photographs. The focus of interpretation has been expanded to include channel characteristics important to fisheries habitat, and the drainage network in the ephemeral and intermittent catchments. (Objective 4)

G. Channel survey. We will resurvey channel cross-sections and profiles on major perennial streams in the Satus Creek watershed to evaluate channel response to high flows. (Objective 4)

H. Characterize stream habitat conditions throughout the Satus watershed. Specific stream segments (approximately 1500') have been selected following standard Washington State ambient habitat monitoring protocols (TFW). A long-term stream segment monitoring strategy includes aerial photo interpretation, channel surveying, channel habitat unit classification, and measurements of canopy coverage, bank stability, gravel embeddedness, large woody debris frequency, temperature, and water quality. Initial monitoring of the selected stream segments has been largely completed. These stream segments will also be targeted for site specific restoration efforts, including those detailed in this methods section (e.g. re-vegetation, burning, large woody debris placements). (Objective 5)

I. Fisheries surveys. Quantify target fish population characteristics and habitat specific biological responses, including abundance, density, growth, and condition of life history cohorts from young-of-the-year fry to migrating smolts, including parr stages. Population characteristics and cohort fate will be compared within and among watershed tributaries. Population sampling has been conducted with electrofishing techniques within the stream habitat monitoring segments, as outlined above. Smolts have been sampled in the lower Satus Creek area, below all contributing tributaries, to obtain an estimate of overall Satus watershed steelhead production. The redds of spawning adults

were surveyed between March and the first half of May, 1997, as in the past, to track overall population trends and identify important spawning reaches for purposes of future conditions analysis (e.g., fine sediment composition). Analysis of monitoring will be performed using the standard procedures established by the TFW Ambient Monitoring Program. (Objective 4)

Continuation of these monitoring protocols will be needed to evaluate the success of the restoration treatments being applied.

J. Experimental treatment development and evaluation. Experimental watershed treatments will be performed on small subwatersheds, and monitored using appropriate combinations of measurements, including: stream gaging, precipitation gaging, channel and floodplain characteristics, and monitoring of survival and growth of juvenile steelhead. (Objectives 1, 2, 3, 4, and 5)

K. Large woody debris placements. Insufficient large woody debris (LWD) has been identified as a factor in channel instability, low channel complexity, and inadequate cover throughout a large portion of the alluvial stream system. We are using a variety of means to increase LWD in the short and long term. In reaches identified as critical spawning and rearing habitat, we have used a helicopter and an excavator to place windthrown trees in the creek. Additionally, we have used the excavator to reposition into the active channel LWD stranded on the floodplain by recent extreme high flows; we will do more of this work in the near future. Also, where accessible, and where instream structure is entirely absent, small clusters of wood posts will be pounded into the streambed to provide locations for the initiation of debris jams. Several of the LWD placements are located within habitat survey segments, thus data have been collected on fish population abundance and density prior to placement; monitoring will assess fish population and habitat changes, and the persistence or downstream/off-channel transport of large woody debris placements. (Objective 2, and 5)

L. Enhance beaver habitat by propagating riparian hardwoods. We are propagating aspen seedlings in a green house for planting in sites suitable for beaver habitat. GIS and aerial photo interpretation, and a literature review on beaver habitat preference are supporting the identification of potential beaver habitat within the watershed. We are reinvigorating and aiding the reestablishment of riparian cottonwood, willow, and aspen stands throughout the Satus Creek watershed through root severing, removal of encroaching conifers, irrigation of point bars, and release of willow sticks under moderately high flow conditions. (Objectives 1, 2, 3, 4, and 5)

M. Plant scattered Ponderosa pine seedlings throughout the mainstem floodplains of Satus, Dry, and Logy Creeks to recreate historic distribution and enhance long term stream shade, bank strength, and high quality large woody debris. (Objective 3, and 5)

N. Rehabilitate incised ephemeral and intermittent channels, especially in headwater meadows. Incised channels around the watershed are being rehabilitated by stabilizing headcuts, constructing sediment traps, and revegetating to capture and stabilize sediments and to promote self-perpetuating channel aggradation. (Objective 1, 2, 3, and 5)

O. Reintegrate fire as a landscape process We will introduce prescribed fire into the Satus Creek basin, with the goals of improving watershed functioning and restoring high quality aquatic habitat. We have contracted with Dr Steve Bunting and Dr Lee Eddleman to prepare an ecologically-based prescribed burning plan for the watershed; the plan is nearly complete. Implementation of this fire reintroduction plan will play a vital role in

ongoing long-term restoration efforts. The in-house analytic and monitoring capabilities of the YIN Department of Natural Resources will allow us to assess the cumulative effects of fire reintroduction on ecosystem functioning and anadromous fish habitat. (Objective 1, 2, 3, 4, and 5)

Our restoration activities are based on the following assumptions:
1. The stream/riparian ecosystem is an expression (integration) of the functioning of the entire watershed, i.e., the landscape-scale interactions between soil, water, and vegetation.
2. Long-term sustainability of aquatic and terrestrial ecosystems rely on developing land uses which allow the soil-water-vegetation interactions to remain within a natural range of variability.
3. Vegetation is the key to stabilizing soils and moderating the routing of water and sediment through the watershed; manipulation of the vegetation is our primary tool for restoring watershed functioning and normative channel conditions.
4. Our restoration activities will gradually alter the routing of soil and water through the watershed, returning them to within the range capable of supporting healthy aquatic ecosystems.

Weather is the critical uncertainty associated with the success of our restoration activities. Various project restoration activities are designed to capitalize on a range of climatic conditions (e.g., high flow periods), however, success in manipulating the vegetation in any given year will still be dependent upon at least moderately favorable weather. The secondary uncertainty lies in the assumption that improving spawning and rearing conditions will increase steelhead numbers in the Satus Creek basin. No single project can encompass the entire steelhead life cycle; this project deals with providing a larger supply of outmigrants to benefit from downstream improvements and accelerate the stock recovery process. Mainstem river and ocean conditions are being addressed by other projects.

f. Facilities and equipment.

The Satus Watershed Project has already acquired virtually all the facilities and equipment required to perform the tasks listed above. Other special equipment needs, such as additional excavator time, will be met by leasing the equipment.

g. References.

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Section 8. Relationships to other projects

The Bonneville Power Administration is funding the Yakima Fisheries Project to supplement spring chinook populations in the Yakima Basin. Planning is underway for supplementing summer steelhead in the Satus Creek watershed and elsewhere in the Yakima Basin. The project's ultimate goal is to increase natural production of salmon and steelhead. Habitat improvements in the Satus Creek watershed will help assure that this goal will be met.

Funding to lease a 12-mile corridor of riparian lands along Satus Creek for 10 years to enhance fish and wildlife was provided by the Bureau of Reclamation in 1995. Livestock exclusion fences have also been constructed along parts of Logy and Mule Dry Creeks in the Satus Creek watershed.

The Yakama Nation's Lower Yakima Valley Wetlands and Riparian Area Restoration Project is receiving $4.9 million from the Bonneville Power Administration to purchase, restore and manage riparian lands along the Yakima River, lower Toppenish Creek, and in lower Satus Creek.

Several fire rehabilitation projects are underway in the Satus Creek watershed. Rehabilitation efforts are generally focused on revegetation and stabilization of severely burned riparian areas. Bank stabilization work along Satus Creek has been funded by the Washington Department of Transportation; the work is being planned and executed by

tribal staff. The Yakama Salmon Corps has performed several revegetation projects in the Satus Creek watershed in 1996 and 1997; more revegetation work is being planned for the upcoming season.

Within the forested portion of the Satus Creek watershed (25% of the total area), The 1993-2002 Yakama Nation Forest Management Plan provides for greater riparian protection and higher forest road construction standards in current and future timber harvest units. Under this plan, 57% of the forested portion is subject to timber harvest limitation to maintain winter wildlife habitat, and another 17% is designated as watershed or subalpine area with no scheduled harvest. The Bureau of Indian Affairs Forest Engineering Unit is providing survey and design services for road relocation to the Satus Watershed Project.

Section 9. Key personnel

The Yakama Indian Nation employs the largest professional natural resources staff of any tribal government. Fully-qualified scientific, technical and support staff are available to carry out all tasks under this project.

Section 10. Information/technology transfer

Our restoration philosophy is to develop and apply large-scale, low input restoration techniques which are compatible with continuing current land uses, which capitalize on natural processes and seasonal opportunity, and which will be applicable throughout the Columbia Basin. Based on our interpretation of historical information, we are learning how land uses have contributed to fish habitat degradation. This provides a historical context for present day adaptive management prescriptions that can integrate watershed restoration and continued land management. Biological results from restoration activities focused on watershed functioning, conducted within a framework of long-term monitoring, will be characterized in future reports and technical papers. Project staff have given oral and poster presentations, and have hosted field trips to the project area for government agencies and media. Such exposure is increasing proportionally with the visibility of project accomplishments.